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LANDSAT Follow-on Investigation 28 600

Investigation of LANDSAT Imagery on Correlations  
between Ore Deposits and Major Shield Structures  
in Finland.

Quarterly Progress Report III  
by Viljo Kuosmanen

Reporting Period Jan.-March 1976

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IMAGERY ON CORRELATIONS BETWEEN ORE DEPOSITS  
AND MAJOR SHIELD STRUCTURES IN FINLAND

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## ABSTRACT

Several lineaments longer than 100 km have been delineated from LANDSAT winter mosaic of Finland by visual interpretation of the image textural patterns connected with the lineaments.

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## 1 INTRODUCTION

In the Baltic Shield several types of important ore deposits and indications of ore are distributed along or near major fracture zones. Owing to glacial drift cover, shallow topography and great width of the zones (up to 50 km) these zones are not easily detected in the field by ground or airborne methods. The purpose of the investigation is to examine the expected advantages of LANDSAT imagery in exploring these structures. The test area for the study is representative of central part of the Shield.

The deep fractures of the Shield are generally faults separating blocks of different character. Owing to repeated rejuvenation they also form lineaments visible in the topography, vegetation, etc. On the other hand, there may be other prominent lineaments which result mainly from glacial flow.

In small-scale LANDSAT mosaics lineaments observable are sequences of complicated figures. Being of interest for ore prospecting, their locations ought to be described with maximum accuracy. During the reporting period attempts have been concentrated in finding these lineaments ( $\geq 100$  km) and in describing them in detail.

Additional LANDSAT imagery has not been received during the reporting period. All the LANDSAT-1 and LANDSAT-2 images of fair quality so far received have been utilized in the present study.

## 2     TECHNIQUES

LANDSAT mosaics (see Kuosmanen, 1976) of scale 1: 500 000 have been used in a search for lineaments possibly indicating major fracture zones. These mosaics, reproduced in scale 1: 5 000 000, are shown in Figs. 1 and 2.

Optical and digital enhancement procedures for comparing LANDSAT imagery with various geophysical, geological and morphological maps have been continued. Bog and water map of Finland has been converted into a rose map using optical filter and rose map computer routines. LANDSAT lineaments are under interpretation.

## 3     ACCOMPLISHMENTS

### 3.1   Expressions of regional lineaments

A minor LANDSAT lineament within a uniform bedrock unit or bedrock assemblage is usually revealed by a high gray-tone contrast to its surroundings and is therefore easy to detect. A regional lineament which may indicate a deep fracture transecting many bedrock units is often composed of a variety aligned figures.

The interrelations of the figures are in many cases not readily visible and misinterpretations may occur.

Several long (100 km or more) lineaments (Fig. 3) have been detected in the winter mosaic. Grey-tone contours of the aligned figures forming the lineaments have been sketched on the map, Fig. 3. An example of manual contouring of the aligned figures is given in Fig. 4. The subsequent figures can be traced by viewing the whole mosaic at low angle along the lineament. The coverage of a single scene ( $185 \times 185 \text{ km}^2$ ) is frequently too small for these lineaments to be detected.

### 3.2 Reliability of the lineaments according to LANDSAT data

The lineaments of Fig. 3 have been divided into three classes (Table 1) according to their reliability as "non-accidental" anomalous sequences of figures. Their significance as reflections of crustal fractures, however, requires comparison with other data.

Table 1 Reliability of the LANDSAT lineaments of Fig. 3.

lineament                      good                      fair                      possible  
in Fig. 3

A			x
B		x	
C +			x
D +	x		
E		x	
F +	x		
G		x	
H	x		
I +			x
J +		x	
K	x		
L +			x
M			x
N			x
O +		x	
P	x		
Q +		x	
R +		x	
S +		x	
T	x		
U +		x	
V		x	
X +		x	
Y		x	

Lineaments with (+) have not been recorded in earlier literature.



## 4 SIGNIFICANT RESULTS

### 4.1 A method to describe lineaments

In most cases a lineament is drawn on a map as a symbolic continuous line along indications of a possible fracture zone. Lineaments are usually sequences of discrete figures and, in many cases, it is possible to decide whether a figure belongs to an already detected lineament or not. The method of drawing down the "in-lineament" figures has the following advantages:

- Width of the lineament becomes expressed,
- Second-order features, which may be of structural importance, become described.
- Reliability of the lineament can be estimated from the indicator-density.

### 4.2 Lineaments observed

Half of the 24 lineaments found in the LANDSAT winter mosaic have not been recorded in earlier literature (see Table 1). The lineaments A, G, H, M, N and P have previously been observed from other data by Tuominen et al. (1973) and the lineaments B, K, M, N and V by Vuorela (1974). Some distinct fracture zones of the basement, however, seem not to be observable as lineaments in the LANDSAT imagery.

The LANDSAT summer mosaic (Fig. 2) has not been found as useful as the winter mosaic for detection of major lineaments.

## 5 REFERENCES

Kuosmanen, V. (1976) Quarterly progress report II, LANDSAT follow on investigation program 28 600 (P.I. Heikki V. Tuominen): Investigation of LANDSAT imagery on correlations between ore deposits and major shield structures in Finland. NASA.

Tuominen, H.V., Aarnisalo, J. and Söderholm, B. (1973) Tectonic patterns in the central Baltic Shield. Bull. Geol. Soc. Finland 45, 205-217.

Vuorela, P. (1974) Ruhjevyöhykkeet ja niiden suhde malmiesiintymiin ja malmeihin Suomessa. (Fracture zones and their relationship to ore deposits in Finland). Unpublished thesis, Dept. of Geology, University of Helsinki.

## 6 ILLUSTRATIONS

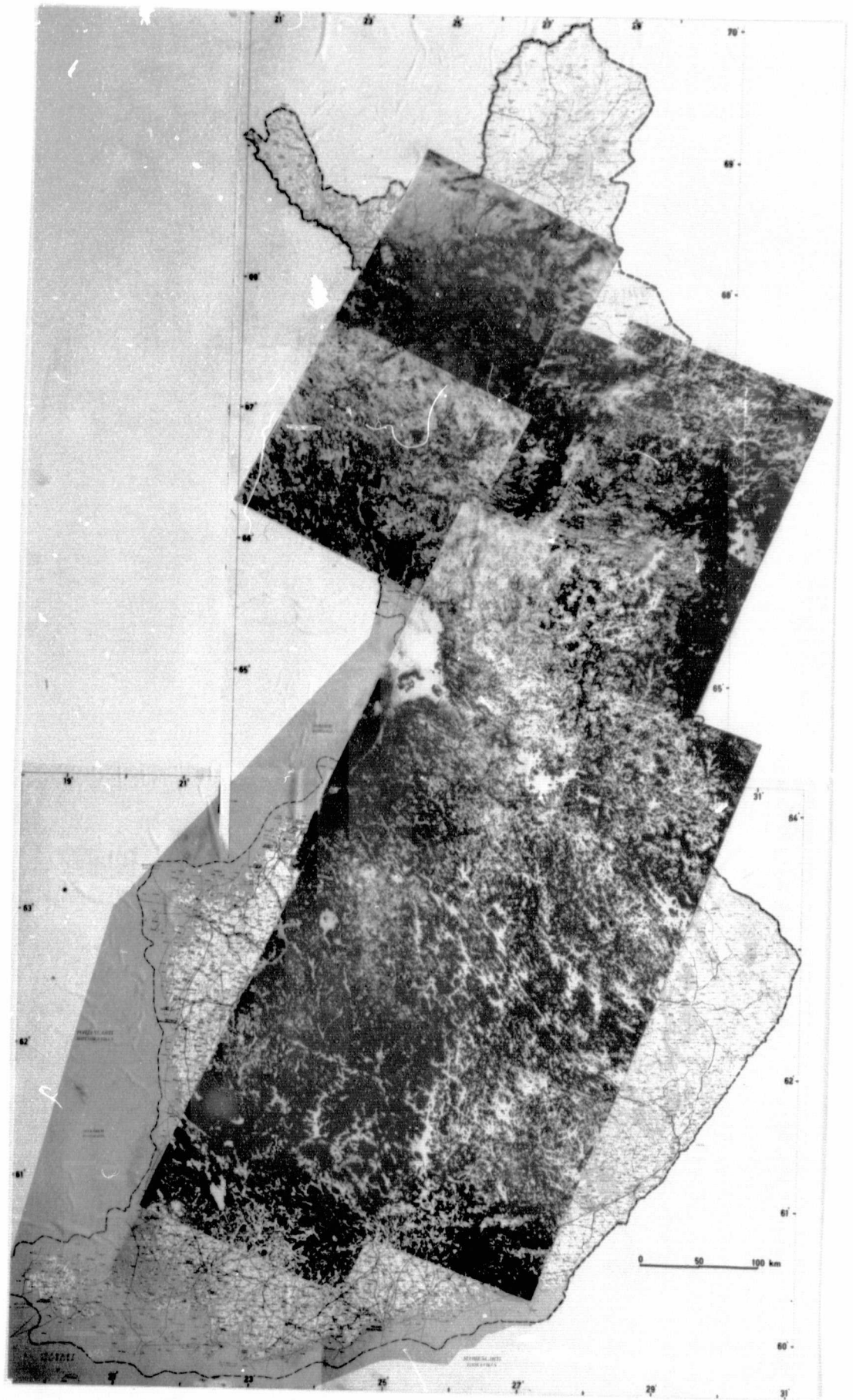


Fig. 1 Mosaic of LANDSAT winter imagery of Finland.



Fig. 2 Mosaic of LANDSAT summer imagery of Finland

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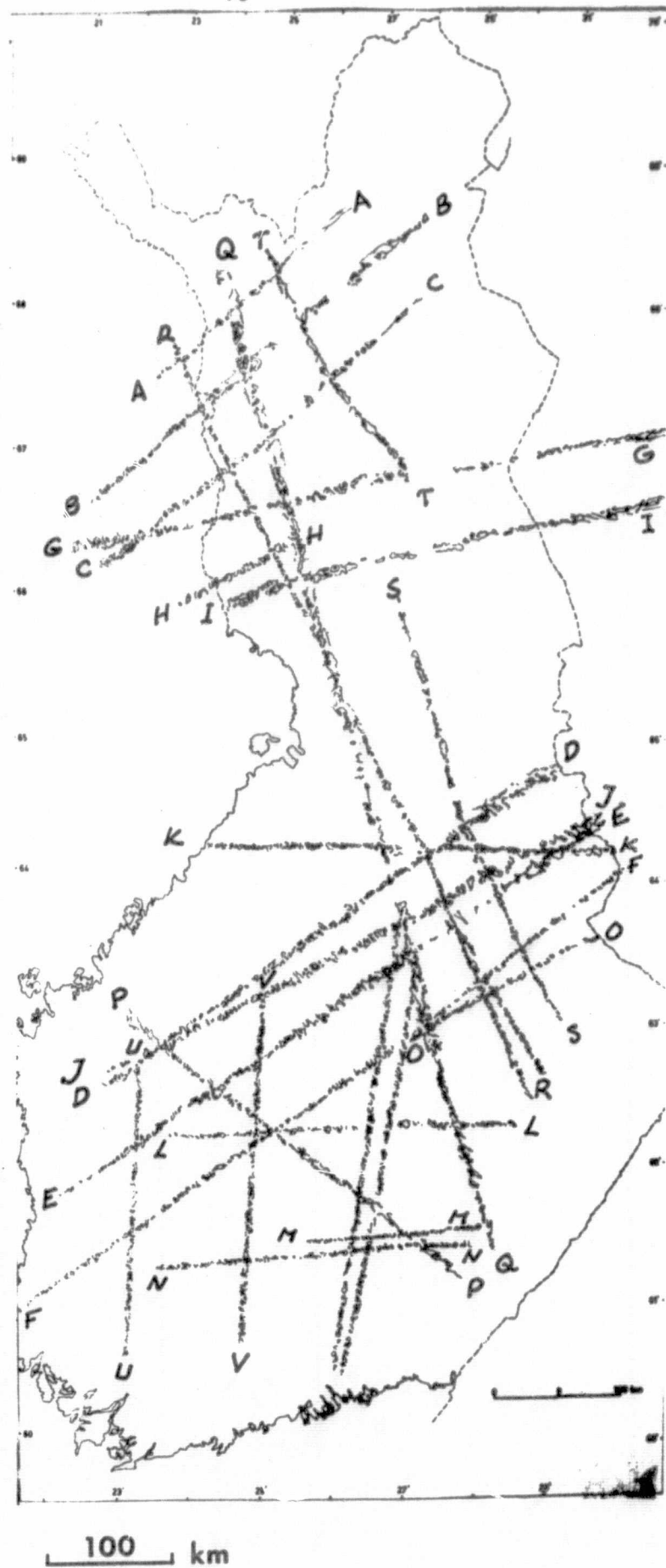
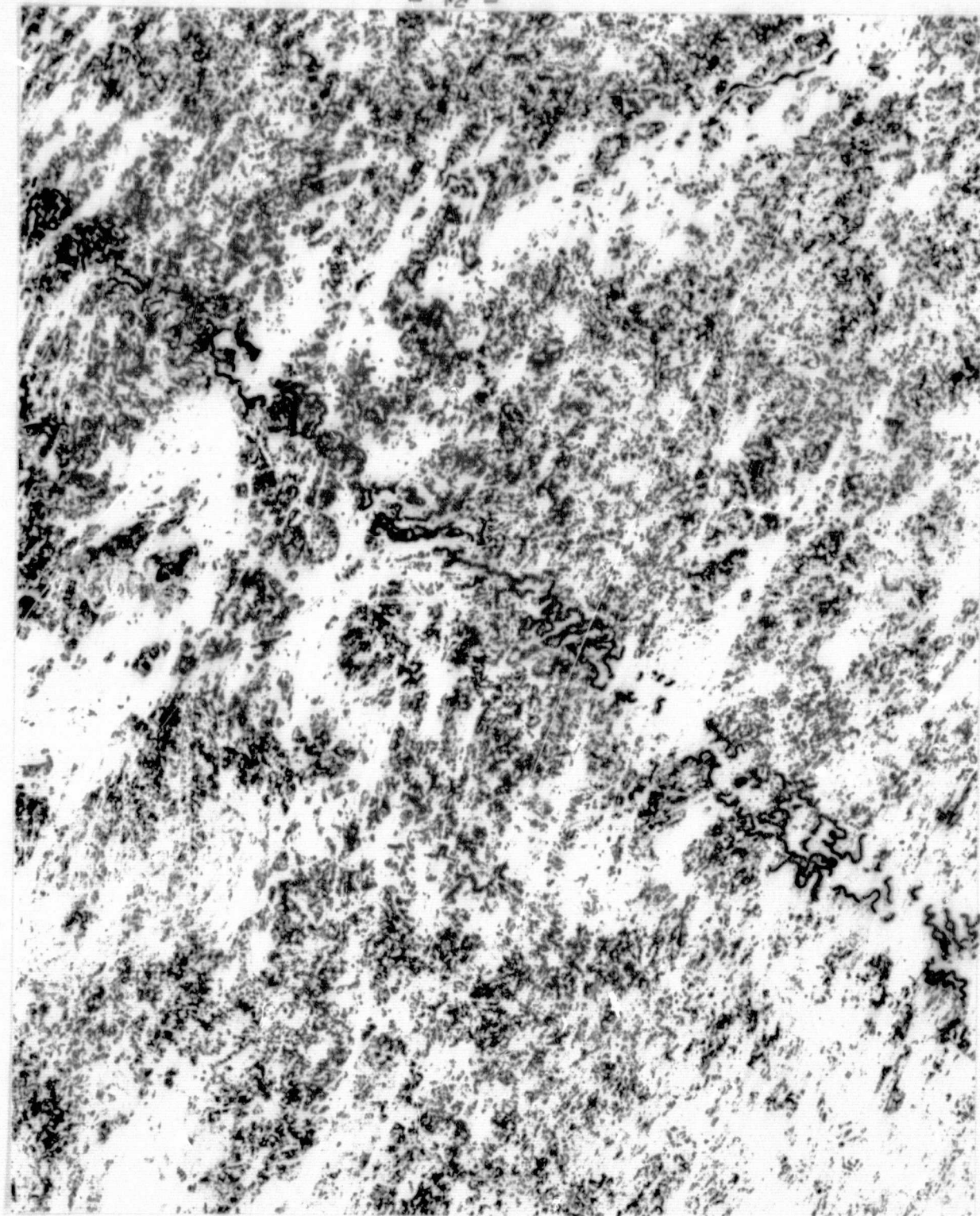


Fig. 3 Regional lineaments of LANDSAT winter mosaics and their expressions by image texture





10 km



Fig. 4 Manual contouring of the aligned figures forming a part of lineament 0-0 in Fig. 3.  
(Scene 2084-08534-7)